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Linking climate change to community-level impacts on copepods via a new, trait-based model: Life-history and metabolic mechanisms compared

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A new, trait-based copepod model ("Coltrane": Copepod Life-history Traits and Adaptation to Novel Environments) has been developed, drawing on past work on both optimal annual routines and trait-based plankton metacommunity models, in order to evaluate climate impacts on copepods via 1) phenology and life history and 2) temperature and energy budgets in a unified framework. In an idealized global-scale testbed, the model correctly predicts life strategies in large *Calanus* spp. ranging from multiple generations per year to multiple years per generation. In a Bering Sea testbed, the model replicates the dramatic variability in the abundance of *C. glacialis*/*marshallae* observed between warm and cold years of the 2000s, and indicates (consistent with recent field studies) that sea ice-linked prey phenology is a more important driver than temperature per se. In a Disko Bay, West Greenland testbed, the model predicts the viability of a spectrum of large-copepod strategies from income breeders with a adult size $\sim 100 \mu\text{gC}$ reproducing once per year through capital breeders with an adult size $> 1000 \mu\text{gC}$ with a multiple-year generation length. This spectrum corresponds closely to the observed life histories and physiology of local populations of *C. finmarchicus*, *C. glacialis*, and *C. hyperboreus*. Furthermore, the model replicates the observed range of stored lipid content of these copepod populations (30–60%, *C. finmarchicus*–*C. hyperboreus*), suggesting a means for linking changes in temperature and primary production to the energy content as well as size structure of the copepod community.

Keywords: copepods, model, life history, climate change, arctic, phenology, lipids

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